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LABORATORY TESTS OF COMPOUNDS FOR TOXICITY TO LARVAE OF THE BANDED CUCUMBER BEETLE

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

LABORATORY TESTS OF COMPOUNDS FOR TOXICITY TO LARVAE OF THE BANDED CUCUMBER BEETLE

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In 1961 various compounds were tested in the laboratory at Charleston, S. C., against larvae of the banded cucumber beetle (Diabrotica balteata LeConte). These tests, designed to select promising compounds for later field testing, were undertaken to meet the problem of insecticide resistance in the banded cucumber beetle and subsequent severe injury to sweet potatoes in Louisiana. This is a report of the results of these tests and not a recommendation of any of the materials tested.

INITIAL TOXICITY TESTS

The insecticides were mixed for 15 minutes with screened, air-dried soil in a small electric pebble mill. Emulsifiable or wettable-powder concentrates of the insecticides were mixed with enough water so that 25 ml. of liquid was added to each quart of soil. The soil mixtures were held in polyethylene bags until used.

Approximately 190 ml. of the treated soil was placed in each of five 1-pint capacity plastic containers within 4 hours after the insecticide was added. Ten 4- to 7-day-old larvae, reared in the laboratory from adults collected at Charleston, S. C., Arnaudville, La., or Baton Rouge, La., were immediately added to each container together with several kernels of wheat as food and approximately 5 ml. of water. An untreated control was included in each group of tests started more than 1 week apart. Results were based on larval mortality after 1 week. The laboratory temperature during the course of these tests was $75^{\circ} \pm 3^{\circ}$ F.

The compounds tested, the dosages, the locations from which the strains were collected, and the mortality of the larvae, adjusted for the untreated checks, are shown in table 1. The chemical names of the new proprietary materials tested precede the table.

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[1] In cooperation with the South Carolina Agricultural Experiment Station at Charleston and the Louisiana Agricultural Experiment Station at Baton Rouge.

RESIDUAL TOXICITY TESTS

The insecticides were mixed into the soil as described for the initial toxicity tests. After being mixed, the treated soil was placed in clay flowerpots, and the pots buried to the rim in a partly shaded location out of doors. This test was begun August 1 and completed November 15. Weekly mean air temperatures ranged from 79.2° to 58.1° F. and rainfall totaled 11.8 inches during this period.

At various intervals after being mixed a portion of the treated soil was brought into the laboratory, and tested for toxicity to larvae of the Charleston, S.C., strain. These tests were made as described for the initial toxicity tests.

The compounds tested, the dosages, the intervals after mixing, and mortality of the larvae, adjusted for the untreated check, are shown in table 2.

DISCUSSION OF RESULTS

In general, organic phosphate compounds were most toxic to larvae of this insect. The most promising of these were Zinophos, phorate, Bayer 38156, Diazinon, and parathion. The commonly used chlorinated hydrocarbon soil insecticides, aldrin, dieldrin, and chlordane were relatively ineffective, but Telodrin, Thiodan, DDT, and Perthane showed promise. The toxicity of aldrin was not increased by the addition of the "antiresistant" compound WARF. The carbamate compound Sevin was toxic at relatively high dosages, but Zectran, another carbamate, showed little toxicity. Bacillus thuringiensis Berliner appeared to be nonpathogenic to larvae of this insect.

Larvae reared from adults collected at Charleston, S.C., and Arnaudville, La., where soil insecticides have been extensively used, appeared to be equally susceptible to all of the insecticides tested against both strains. Aldrin was ineffective against larvae from both areas. Larvae reared from adults collected at Baton Rouge, La., where soil insecticides have been less generally used, appeared to be more susceptible to aldrin and possibly DDT than the ones from the other two areas.

Best residual action was exhibited by the chlorinated hydrocarbons Telodrin, Thiodan, and DDT. These showed little or no loss in toxicity for 106 days. Bayer 38156 was the only organic phosphate tested that exhibited appreciable residual action and it lost most of its toxicity in 106 days. Parathion, Zinophos, Diazinon, and phorate were essentially nontoxic after 28 days.

CHEMICAL NAMES OF THE PROPRIETARY MATERIALS TESTED

Bayer 30911 -------- *O*-(2, 4-dichlorophenyl) *O*-methyl methylphosphonothioate

Bayer 38156 -------- *O*-ethyl *S*-*p*-tolyl ethylphosphonodithioate

Delnav ------------- a mixture of 2, 3-*p*-dioxanedithiol *S*, *S*-bis(*O*, *O*-diethyl phosphorodithioate) (70%) and related compounds

Diazinon ------------ *O*, *O*-diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate

Guthion ------------- *O*, *O*-dimethyl *S*-(4-oxo-1, 2, 3-benzotriazin-3-(4*H*)-ylmethyl) phosphorodithioate

Kepone ------------- decachlorooctahydro-1, 3, 4-metheno-2*H*-cyclobuta[*cd*] pentalen-2-one

Perthane------------ a mixture of diethyl diphenyl dichloroethane (95%) and related reaction products (5%)

Sevin --------------- 1-naphthyl *N*-methylcarbamate

Telodrin ------------ 1, 3, 4, 5, 6, 7, 8, 8-octachloro-1, 3, 3a, 4, 7, 7a-hexahydro-4, 7-methanoisobenzofuran

Thiodan------------- 6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-methano-2, 4, 3-benzodioxathiepin-3-oxide

Trithion ------------ *O*, *O*-diethyl *S*-*p*-chlorophenylthiomethyl phosphorodithioate

V-C 13 Nemacide ---- *O*-2, 4-dichlorophenyl *O*, *O*-diethyl phosphorothioate

WARF Antiresistant-- *N*, *N*-dibutyl-*p*-chlorobenzenesulfonamide

Zectran ------------ 4-dimethylamino-3, 5-xylyl methylcarbamate

Zinophos ----------- *O*, *O*-diethyl *O*-2-pyrazinyl phosphorothioate

Table 1.--Initial toxicity of soil mixtures of various compounds to larvae of the banded cucumber beetle in laboratory cages

Compound	Strain of insect [1]	Percent mortality at indicated dosage (equivalent pounds of toxicant per 6-inch acre)[2]																			
		0.03	0.06	0.125	0.25	0.5	0.75	1	1.5	2	2.5	4	5	6	7.5	8	10	12	15	20	30
Zinophos	C	17	22	61	100	100	--	100	--	100	--	--	--	--	--	--	--	--	--	--	--
	A	--	--	50	89	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phorate	C	--	--	--	69	100	--	100	--	--	--	--	--	--	--	--	--	--	--	--	--
	A	--	--	--	74	--	--	95	--	100	--	--	--	--	--	--	--	--	--	--	--
Bayer 38156	C	--	--	--	--	75	--	100	--	100	--	--	--	--	--	--	--	--	--	--	--
	A	--	--	--	0	--	--	90	--	100	--	--	--	--	--	--	--	--	--	--	--
Diazinon	C	--	--	--	--	63	--	100	--	100	--	--	--	100	--	--	--	--	--	--	--
	A	--	--	--	--	72	--	100	--	--	--	--	--	--	--	--	--	--	--	--	--
Parathion	C	--	--	--	--	38	42	81	100	100	--	--	--	--	--	--	--	--	--	--	--
	A	--	--	--	--	29	54	62	95	100	--	--	--	--	--	--	--	--	--	--	--
Guthion	C	--	--	--	--	10	--	10	--	90	--	--	--	--	--	--	--	--	--	--	--
Endrin	C	--	--	--	--	--	--	20	--	--	--	--	24	--	--	--	14	--	--	--	--
Telodrin	C	--	--	--	--	--	--	--	--	72	--	88	--	--	--	100	--	100	--	--	--
	A	--	--	--	--	--	--	--	--	100	--	100	--	--	--	--	--	--	--	--	--
Delnav	C	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--	--
Bayer 30911	C	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--
	A	--	--	--	5	--	--	24	--	10	--	71	--	--	--	--	--	--	--	--	--
V-C 13	C	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--
Trithion	C	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--
Ethion	C	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--
Dimethoate	C	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--
DDT	C	--	--	--	--	--	--	--	--	--	--	16	22	--	38	--	74	--	85	95	100
	A	--	--	--	--	--	--	--	--	--	--	--	21	--	58	--	78	--	100	95	--
	B	--	--	--	--	--	--	--	--	--	--	--	67	--	--	--	89	--	--	94	--
Sevin	C	--	--	--	--	--	--	--	--	--	--	11	16	--	67	--	100	--	--	--	--
	A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	44	83	--	--	--	--
Thiodan	C	--	--	--	--	--	--	--	--	--	--	71	78	--	--	--	87	84	--	88	--
	A	--	--	--	--	--	--	--	--	--	--	--	75	--	--	--	83	--	--	100	--
Aldrin	C	--	--	--	--	--	--	--	--	--	--	19	5	--	--	--	23	11	--	14	--
	A	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	25	--	--	33	--
	B	--	--	--	--	--	--	--	--	--	--	--	50	--	--	--	61	--	--	83	--
Aldrin + WARF anti-resistant (2-1)	C	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--
Aldrin + WARF Anti-resistant (1-4)	C	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--
Dieldrin	C	--	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	81	--	--	--
Perthane	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	89	--	--	100	--
Zectran	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	75	--	--	--	--
	A	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	31	--	--	--	--
Kepone	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--
Chlordane	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--	--
Toxaphene	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--
Bacillus thuringiensis[3]	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--

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[1] A-Arnaudville, La., B-Baton Rouge, La., C-Charleston, S.C.

[2] Mortality corrected for untreated check.

[3] Commercial spore material containing 75 x 10^9 spores per gram.

Table 2.--Residual toxicity of soil mixtures of certain compounds to larvae of the banded cucumber beetle

Compound	Equivalent pounds of toxicant per 6-inch acre	Percent mortality at indicated interval (days) after mixing[1]			
		0	28	77	106
Telodrin	8	100	96	100	100
DDT	20	95	61	83	100
Thiodan	12	84	65	83	71
Bayer 38156	2	100	91	67	23
Parathion	2	100	17	--	--
Zinophos	2	100	9	--	--
Diazinon	2	100	9	--	--
Phorate	2	100	4	--	--

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[1] Mortality corrected for untreated check.

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